

What is claimed is:

1 1. A variable cam timing phaser for an internal combustion engine having at least one  
2 camshaft comprising:

3 a housing having an outer circumference for accepting drive force;

4 a rotor for connection to a camshaft coaxially located within the housing,  
5 the housing and the rotor defining at least one vane separating a  
6 plurality of chambers, at least one chamber being an advance  
7 chamber and another chamber being a retard chamber, the vane  
8 being capable of rotation to shift the relative angular position of the  
9 housing and the rotor;

10 a spool valve comprising a spool having a plurality of lands slidably  
11 mounted within a bore in the rotor, the spool slidable from an  
12 advance position through a holding position to a retard position, and  
13 having an advance exhaust passage, a retard exhaust passage, and a  
14 return passage to route operating fluid to the advance and retard  
15 chambers, wherein the advance exhaust passage and the retard  
16 exhaust passage are coupled to the return passage; and

17 a recirculation check valve in the return passage oriented such that flow of  
18 the operating fluid flows only from the advance chamber through  
19 the advance exhaust passage and into the return passage when the  
20 spool is in the retard position and operating fluid flows only from  
21 retard chamber through the retard exhaust passage and into the  
22 return passage when the spool is in the advance position.

1 2. The phaser of claim 1, further comprising a supply of operating fluid having a check  
2 valve.

1 3. The phaser of claim 1, further comprising a supply passage coupled to the return line.

1 4. The phaser of claim 1, further comprising a supply passage coupled to inlet lines to the  
2 advance chamber and the retard chamber.

- 1 5. The phaser of claim 4, further comprising a check valve in each supply passage coupled
- 2 to the inlet lines of the advance chamber and the retard chamber.